National Aeronautics and
Space Administration

John F. Kennedy Space Center

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Pressure Transducer Remote Calibration / Health Check

Dynacs, Inc.

For

NASA Spaceport Engineering & Technology Directorate

Command & Control Branch

Transducers Development Laboratory

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Objectives

- To provide a long term solution to determining the calibration of pressure transducers for gas applications
- To provide a method of isolating problems in remote measurements
- To reduce costs and resources by extending the length of time a transducer may be left in a system without a repeat laboratory calibration
- Develop An In-situ Pressure Transducer Calibration System For Extension Of Calibration Lifecycle And Transducer Health Determination

Design Requirements

- Must be rugged enough to withstand launch and/or operation during planetary missions
- Must be designed to prevent system failure in the event of a calibration failure
- Must utilize available commodity and not waste any commodity during calibration/health check operations
- Must be capable of remote operation to efficiently determine system health and ensure measurement reliability
  - **For ground-based or space-based operation**

Design Assumptions

- Only Three Items Will Change The Original Calibration:
  - A change in the sensitivity of the transducer electronics associated with the measurement
  - A mechanical change in the pressure diaphragm sensitivity
  - A shift in the transducer "zero"

- If the sensitivities have not changed, the "zero" will remain within the manufacturers specification

Assumptions (continued)

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- Electronic Sensitivity is check by the "tried and true" method of shunting the bridge with a precision resistor
- During the calibration of the measurement, the value of this resistor and the offset are determined
- As long as the offset is the same, during this calibration operations (shunt resistor across one leg of the bridge), the sensitivity of the electronic package has not changed

Assumptions (continued)

- Verification of the mechanical diaphragm element is the more difficult task
- In order to verify the mechanical function of the pressure transducer, the diaphragm must be moved in a totally repeatable manner
- This is normally accomplished by applying a precise pressure to the input and reading the output
- Presently, generating an independent precision pressure in a remote location is a very expensive project and violates requirements.
  - **Some portion of the system must be vented to expose the transducer to a precision source**
  - **Expensive equipment must be utilized as a precision source**

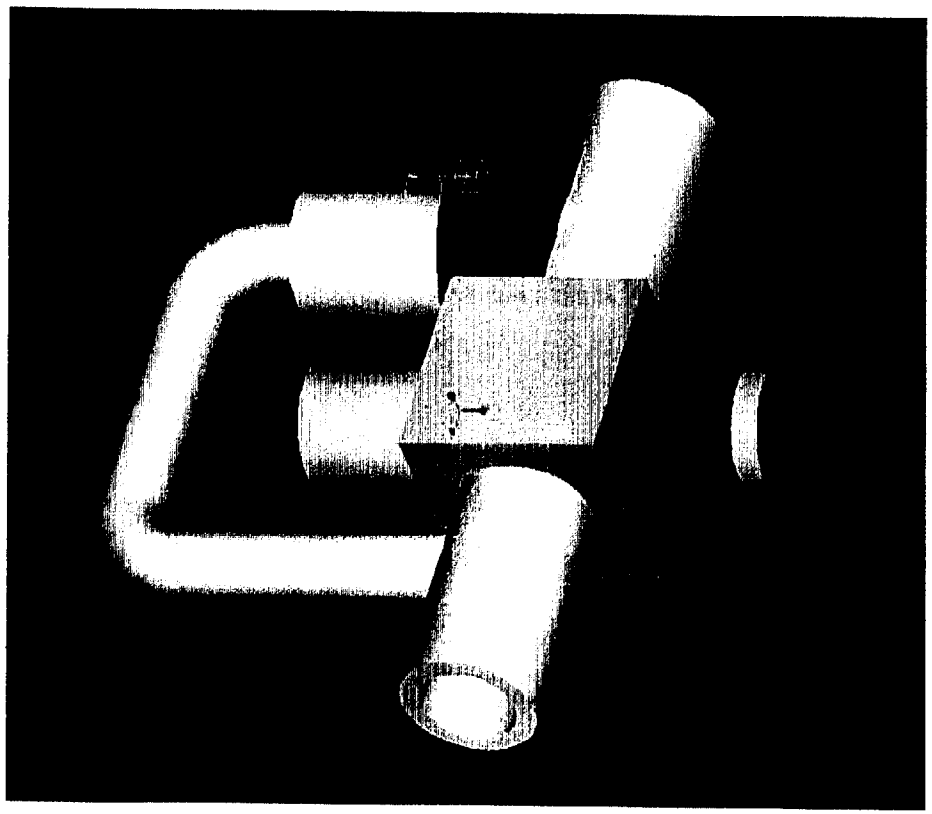
Design Approach

- The design and method utilizes an entrapped volume and a precision volume change to raise the pressure and cause the diaphragm to deflect an exact amount each time the function is performed.
  - **If the output of the transducer changes the same amount that it did during the calibration, the mechanical sensitivity of the diaphragm has not changed.**

- If the electronic and mechanical sensitivities have not changed, the zero is within the manufacturers specifications.

Design

- Prototype design utilizes ¼ " stainless steel tubing.
- A valve is used for isolation and entrapment of a volume.
- A piston is utilized to displace a volume and provide a precision pressure change.
- The goal for the prototype size is an envelope of 1¼ X 1¼ X $^{3}/_{8}$ inches.



Process (+ Pressure)

- To perform a calibration run using a Positive Pressure Change:

1. **The piston is drawn completely into the cylinder**
2. **The valve is closed to isolate a volume**
3. **The output of the pressure transducer is read ($P_{initial}$)**
4. **The piston is extended to change the volume & pressure**
5. **The output of the pressure transducer is read (ΔP_{+})**
6. **The piston is withdrawn into the cylinder**
7. **The output of the pressure transducer is read (P_{final})**
8. **Valve is opened**

Process (+ Pressure)

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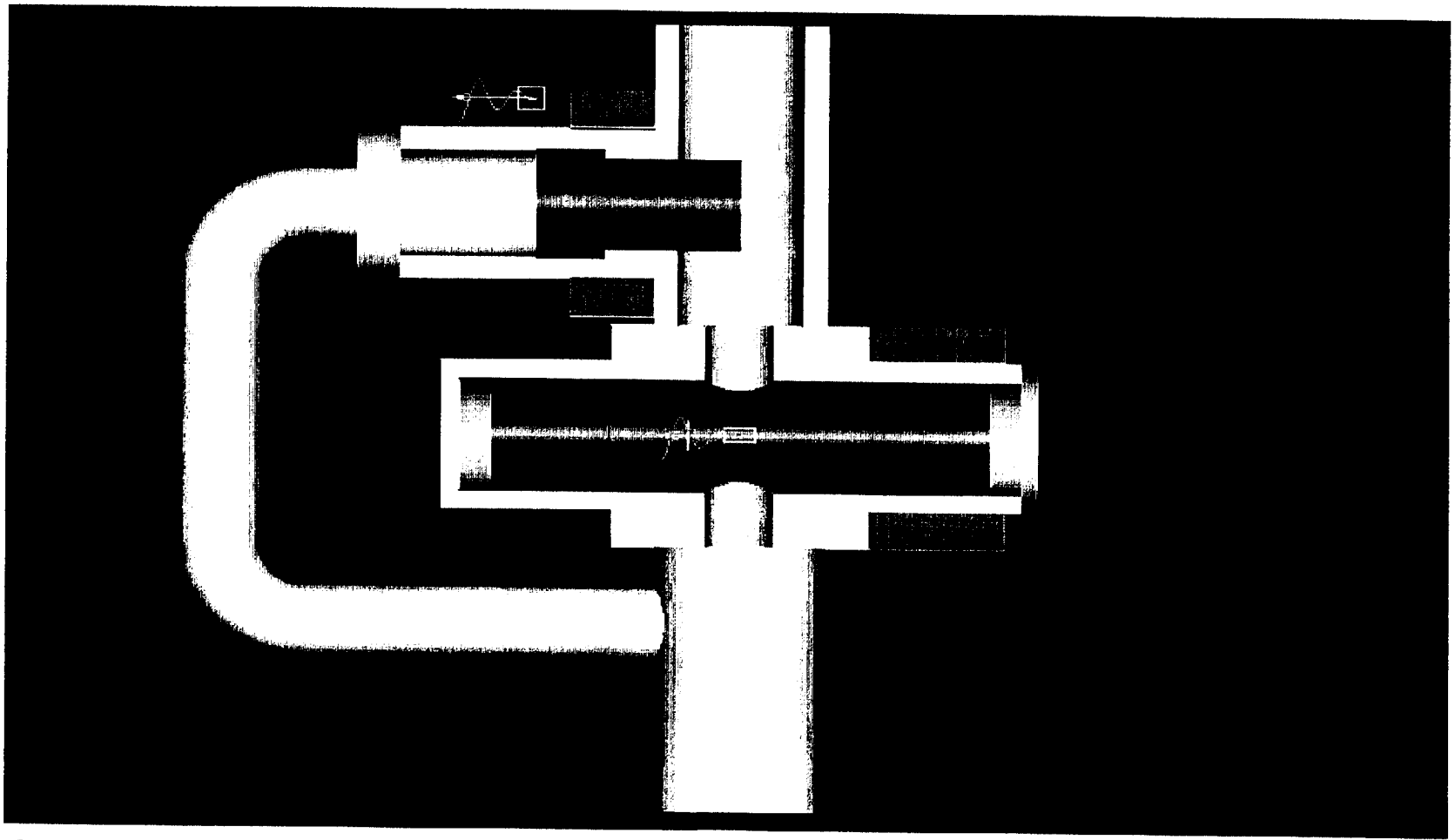

Process (- Pressure)

- To perform a calibration run using a Negative Pressure Change:

1. **The piston is extended completely into the volume**
2. **The valve is closed to isolate a volume**
3. **The output of the pressure transducer is read ($P_{initial}$)**
4. **The piston is withdrawn to change the volume & pressure**
5. **The output of the pressure transducer is read (ΔP_{-})**
6. **The piston is extended back into the volume**
7. **The output of the pressure transducer is read (P_{final})**
8. **Valve is opened**

Process (- Pressure)

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